section 4

Transportation, Energy and the Environment

table 4-1

Energy Consumption by the Transportation Sector

(Exajoules, 10 to the 18 joules)

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1990	1995	1996
Energy consumption, total[a]	**7.84**	**8.59**	**8.98**	**5.16**	**5.49**	**5.90**	**88.75**	**95.86**	**99.04**
Transportation consumption, total[b]	**2.04**	**2.27**	**2.33**	**1.28**	**1.40**	**1.44**	**23.78**	**25.40**	**26.02**
Transportation's share of total energy consumption (percent)	26.0	26.4	25.9	24.8	25.5	24.4	26.8	26.5	26.3
Fossil fuels, total exajoules[c]	2.03	2.26	2.31	N	N	N	23.73	25.35	25.98
Natural gas (exajoules)	0.14	0.24	0.25	N	N	N	0.72	0.76	0.77
Trillion cubic meters	0.0035	0.0063	0.0065	N	N	N	0.0187	0.0198	0.0201
Petroleum (exajoules)	1.89	2.01	2.06	1.27	1.40	1.43	23.01	24.59	25.20
Million barrels	329	351	359	211	243	249	4,004	4,281	4,385
Electricity[b]	0.012	0.014	0.014	0.003	0.003	0.004	0.015	0.014	0.014

[a]For all three countries, energy consumption, total **includes** electrical system energy losses.

[b]For all three countries, transportation consumption, total and electricity do **not** include electrical system energy losses.

[c]Coal is not included in this table, because all three countries use negligible amounts of coal for transportation.

KEY: N = Data are nonexistent.

NOTES

Canada

Energy consumption, total: Includes renewable energy.

Transportation consumption, total: Incudes fuel used in fisheries and in private trucking but excludes fuel consumption by public administrations.

Mexico

Natural gas: Data are nonexistent, but natural gas consumption in Mexico is estimated to be quite small.

United States

Energy consumption, total: Includes renewable energy.

Transportation consumption, total: Total is greater than the sum of the components, because electrical system energy losses are not listed. Fisheries are not included, but fuel consumption by public administrations is included.

SOURCES

Canada

Statistics Canada. *Quarterly Report on Energy Supply-Demand in Canada, Catalogue No. 57-003-XPB.* (Ottawa, Ont.: various editions).

Mexico

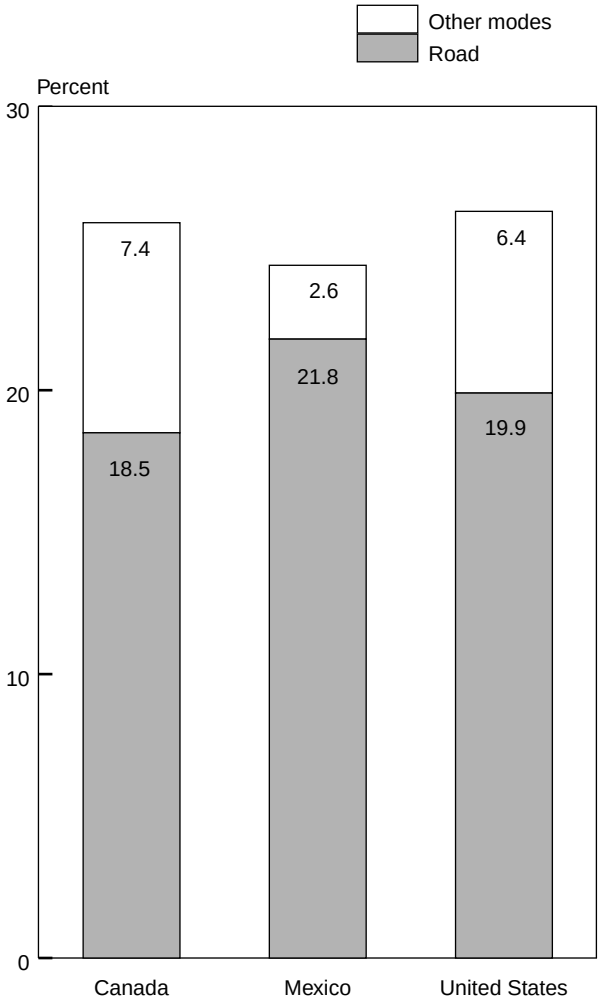
Secretaría de Energía. *Balance Nacional, Energía. 1996.* (Mexico City, D.F.: 1998).

United States

U.S. Department of Energy. Energy Information Agency. *Annual Energy Review, 1997* and *Monthly Energy Review, August 1998.* (Washington, DC: 1998).

figure 4-1

Transportation's Percent Share of Total Energy Consumption: 1996



Total energy consumption, Mexico: Pipeline energy consumption is not included in Mexico's transportation energy consumption figures. If pipeline data were included, the share of other modes would be greater and transportation's share of total energy consumption would also be more.
Notes and sources: See Tables 4-1 and 4-2.

table 4-2

Energy Consumption by Mode of Transportation

(Petajoules, 10 to the 15th joules)

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1990	1995	1996
Total	**2,037.7**	**2,269.1**	**2,325.1**	**1,275.3**	**1,399.1**	**1,435.2**	**23,780**	**25,400**	**26,020**
Air	**185.2**	**185.1**	**205.8**	**73.6**	**95.4**	**93.4**	**1,910**	**1,937**	**1,995**
Jet fuel	179.7	181.0	201.9	71.9	91.5	92.2	1,865	1,902	1,959
Aviation gasoline	5.5	4.1	3.9	1.7	3.9	1.2	45	35	36
Road	**1,494.4**	**1,631.3**	**1,661.0**	**1,147.0**	**1,253.5**	**1,289.1**	**N**	**19,278**	**19,752**
Gasoline	1,176.0	1,213.7	1,229.4	837.9	928.9	944.4	14,445	15,438	15,762
Diesel	292.5	384.5	397.5	293.9	306.0	325.5	3,100	3,800	3,950
Other fuels	25.9	33.1	34.1	15.2	18.6	19.2	N	40	40
Pipeline	**142.4**	**245.3**	**254.5**	**U**	**U**	**U**	**718**	**762**	**774**
Natural gas	133.1	232.9	241.5	U	U	U	718	762	774
Electricity	8.7	11.0	10.8	U	U	U	U	U	U
Diesel	0.6	1.4	2.2	U	U	U	U	U	U
Rail	**89.5**	**80.9**	**79.1**	**26.6**	**22.6**	**24.7**	**469**	**520**	**536**
Distillate/diesel fuel	89.5	80.9	79.1	26.6	22.6	24.7	468	519	535
Freight rail	87.2	78.8	77.0	U	U	U	456	509	524
Intercity passenger	2.3	2.1	2.1	U	U	U	12	10	11
Electricity				U	U	U			
Intercity passenger	NS	NS	NS	U	U	U	1	1	1
Transit	**19.0**	**24.6**	**23.5**	**N**	**N**	**N**	**N**	**125**	**123**
Electricity	3.1	3.0	3.0	2.7	3.5	3.6	17	18	18
Motor fuels									
Gasoline	0.5	0.4	NS	N	N	N	4	6	6
Diesel	12.8	13.4	12.7	N	N	N	95	99	97
Compressed natural gas	2.6	7.8	7.8	N	N	N	N	2	2
Water transport	**107.3**	**102.0**	**101.3**	**N**	**N**	**N**	**1,472**	**1,412**	**1,396**
Residual fuel oil	60.1	55.7	55.3	20.7	1.4	1.6	999	930	900
Distillate/diesel fuel oil	47.2	45.5	45.4	4.7	22.7	22.9	302	342	365
Gasoline	NS	0.8	0.6	N	N	N	171	140	131

KEY: N = Data are nonexistent. NS = Not significant. U = Data are unavailable.

NOTES

All Countries

Transportation energy consumption: Electrical systems energy losses are excluded from the overall total as well as individual modal totals.

Transit: Canadian and U.S. data refer to **all transit**, including local transit buses and other road transit vehicles, which are also reported under road. Some ferryboats are also included.

Mexico

Road, other fuels: Refers to liquified petroleum gas.

Road, gasoline, diesel, other fuels: Includes data on transit, motor fuels, and no breakdown is possible.

Rail, distillate/diesel fuel: Includes passenger and cargo services, and no breakdown is possible.

Transit, motor fuels: Data for subcategories cannot be separately identified for transit. Instead they are included in the fuel categories for road (gasoline, diesel and other fuels).

Water transport, residual fuel oil, distillate/diesel fuel oil: In 1991, vessel fuel usage began to change. Diesel began to be subsituted for residual fuel oil.

United States

Total: The total differs from the sum of the individual modes for reasons discussed in Appendix B.

table 4-2

Energy Consumption by Mode of Transportation–*Continued*

SOURCES

Canada

All modes except transit rail: Statistics Canada. *Quarterly Report on Energy Supply-Demand in Canada, Catalogue No. 57-003-XPB.* (Ottawa, Ont.: various quarterly editions).

Natural Resources Canada. *Canada's Energy Outlook 1996-2020.* (Ottawa, Ont.: 1998).

Transit rail: Statistics Canada. *Passenger Bus and Urban Transit Statistics, Catalogue No. 53-215-XPB.* (Ottawa, Ont.: various years).

Mexico

Secretaría de Energía. *Balance Nacional, Energía. 1996.* (Mexico City, D.F.: 1998).

Comisión Nacional para el Ahorro de Energia. Private communication. (Mexico City, D.F.: 1998).

United States

Total: U.S. Department of Energy. Energy Information Administration. *Annual Energy Review, 1997.* (Washington, DC: 1998).

Air: U.S. Department of Transportation. Bureau of Transportation Statistics. Office of Airline Information. Private Communication. (Washington, DC: 1998).

U.S. Department of Transportation. Federal Aviation Administration. *General Aviation and Avionics Survey.* (Washington, DC: various years).

Road: U.S. Department of Transportation. Federal Highway Administration. *Highway Statistics, Summary to 1995.* (Washington, DC: 1996).

U.S. Department of Transportation. Federal Highway Administration. *Highway Statistics, 1996.* (Washington, DC: 1997).

U.S. Department of Energy. Energy Information Administration. *Alternatives to Traditional Transportation Fuels, 1996.* (Washington, DC: 1997).

Pipeline: U.S. Department of Energy. *Natural Gas Annual 1996.* (Washington, DC: 1997).

Rail: Association of American Railroads. *Railroad Facts, 1997 Edition.* (Washington, DC: 1997).

National Railroad Passenger Corp. State and Local Affairs Department. Private Communication. (Washington, DC: 1998).

National Railroad Passenger Corp. Director of Fuel Management. Private Communication. (Washington, DC: 1998).

American Public Transit Association. *Transit Fact Book.* (Washington, DC: various years).

American Public Transit Association. Private Communication. (Washington, DC: 1998).

Water transport: U.S. Department of Energy. Energy Information Administration. *Fuel Oil and Kerosene Sales.* (Washington, DC: various years).

U.S. Department of Transportation. Federal Highway Administration. *Highway Statistics, 1996.* (Washington, DC: 1997).

table 4-3

Estimated Consumption of Alternative and Replacement Fuels for Road Motor Vehicles

(Thousand gasoline-equivalent liters)

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1992[a]	1995	1996
Fuel consumption, total	**42,324,176**	**46,177,399**	**46,997,886**	**N**	**N**	**N**	**508,118,000**	**548,035,000**	**560,929,000**
Alternative fuels, total	**824,370**	**1,179,468**	**1,210,743**	**N**	**N**	**N**	**869,248**	**1,050,478**	**1,125,142**
Liquified petroleum gases (LPG)	748,240	954,847	985,256	N	N	N	787,903	880,869	905,312
Compressed natural gas (CNG)	76,110	224,321	225,187	N	N	N	63,682	133,103	177,623
Liquified natural gas (LNG)	0	0	0	N	N	N	2,214	10,444	12,291
Methanol, 85 percent (M85)	20	300	300	N	N	N	4,047	10,928	12,833
Methanol, neat (M100)	0	0	0	N	N	N	9,641	8,139	1,314
Ethanol, 85 percent (E85)	0	0	0	N	N	N	79	719	2,627
Ethanol, 95 percent (E95)	0	0	0	N	N	N	322	3,766	10,217
Electricity	**NS**	**NS**	**NS**	**N**	**N**	**N**	**1,359**	**2,510**	**2,926**
Oxygenates									
Methyl tertiary butyl ether (MTBE)	NS	NS	NS	N	N	N	4,448,000	10,187,300	10,408,700
Ethanol in gasohol	10,000	40,000	40,000	N	N	N	2,654,000	3,447,400	2,499,100
Traditional fuels									
Gasoline	33,928,534	35,017,600	35,471,523	N	N	N	416,906,000	438,892,000	445,857,000
Diesel	7,561,272	9,940,331	10,275,620	N	N	N	90,343,000	108,092,590	113,946,310

[a]U.S. data for 1990 are not available. Nearest data year is 1992.

KEY: N = Data are nonexistent. NS = Not significant.

NOTE

Mexico

Alternative fuels, liquefied petroleum gases: In Table 4-2 under road, other fuels, an estimation of fuel consumption in petajoules is shown.

SOURCES

Canada

Natural Resources Canada. Office of Energy Efficiency. (Ottawa, Ont.: 1998).

United States

U.S. Department of Energy. Energy Information Administration. *Alternatives to Traditional Transportation Fuels, 1996.* (Washington, DC: 1997).

table 4-4

Average Price[a] of Fossil Fuel to End-Users

(Current U.S. cents per liter)

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1990	1995	1996
Motor vehicle fuel									
Gasoline									
Leaded	NA	NA	NA	25.2	33.6	36.8	30.4	NA	NA
Unleaded premium	54.0	47.2	49.4	NA	NA	41.8	35.6	35.3	37.3
Unleaded regular	50.1	40.4	42.5	35.6	34.9	37.9	30.7	30.3	32.5
Average over all types									
Price with taxes	U	U	U	U	U	U	32.1	31.8	34.0
Taxes	19.6	19.5	19.9	U	U	U	6.5	9.7	9.8
Diesel									
Price with taxes	43.1	30.7	31.7	21.5	25.5	28.2	U	29.3	32.6
Taxes	15.3	12.2	12.3	U	U	U	8.2	11.5	11.4
Aviation fuel									
Gasoline	42.1	31.3	31.6	35.6	34.9	37.9	29.6	26.5	29.5
Jet fuel	22.1	14.1	15.4	25.2	17.8	23.4	20.3	14.4	17.1
Rail fuel									
Diesel	23.5	15.7	17.1	21.5	25.5	28.2	18.3	15.9	17.9
Water transport									
Combined fuels	14.4	10.1	11.6	8.1	6.5	13.2	U	10.1	11.0

[a]Unless otherwise stated in the country notes below, prices include the cost of the fuel and taxes. Taxes are given separately in this table only for all types of motor vehicle gasoline and for motor vehicle diesel fuel. See Appendix B for information on fuel taxes in each country.

KEY: NA = Not applicable. U = Data are unavailable.

NOTES

Mexico

Data refer to sales price to the public as of December 31 of each year.

United States

Motor vehicle fuel taxes: Sales weighted average of Federal and state fuel taxes only. Does not include state sales taxes. If these were included, they would raise the average tax in 1996 by roughly half a cent per liter for both gasoline and diesel. Note that the motor vehicle fuel prices do include state sales taxes.

Aviation fuel: Does not include any taxes. Price of jet fuel is that paid by the large certified air carriers, which are defined in Appendix B.

Rail fuel: Price includes federal fuel taxes only, no state taxes are included.

table 4-4

Average Price[a] of Fossil Fuel to End-Users–*Continued*

SOURCES

Canada

Natural Resources Canada. Office of Energy Efficiency. (Ottawa, Ont.: 1998).

Mexico

Petróleos Mexicanos. *Anuario Estadístico, 1998.* (Mexico City, D.F.: 1999).

Petróleos Mexicanos. PEMEX-Refinación. Subgerencia de Planeación (Mexico City, D.F.: 1999)

United States

Motor vehicle fuel: U.S. Department of Energy. Energy Information Administration. *Annual Energy Review 1997.* (Washington, DC: 1998).

U.S. Department of Transportation. Federal Highway Administration. *Highway Statistics, Summary to 1995.* (Washington, DC: 1996).

U.S. Department of Transportation. Federal Highway Administration. *Highway Statistics, 1996.* (Washington, DC: 1997).

Aviation fuel, gasoline: U.S. Department of Energy. Energy Information Administration. *Annual Energy Review, 1997.* (Washington, DC: 1998).

Aviation fuel, jet fuel: U.S. Department of Transportation. Bureau of Transportation Statistics. Office of Airline Information. Private Communication. (Washington, DC: 1998).

Rail fuel: Association of American Railroads. *Railroad Facts, 1997 Edition.* (Washington, DC: 1997).

Rail fuel taxes: Association of American Railroads. Private Communication. (Washington, DC: 1998).

Water transport: U.S. Department of Transportation. Maritime Administration (MARAD). Private Communication. (Washington, DC: 1998).

table 4-5

New Model Year Fuel Efficiency for Road Motor Vehicles

(Liters per 100 kilometers)

	Canada			Mexico			United States		
	1990	1995	1996	1990	1995	1996	1990	1995	1996
Sales weighted average									
Passenger cars	8.2	7.9	7.9	9.1	8.0	7.8	8.4	8.2	8.2
Light trucks	11.4	11.5	11.3	U	U	U	11.3	11.5	11.4
Range									
Passenger cars	20.8 to 5.0	19.4 to 4.9	17.9 to 4.9	U	9.28 to 6.9	10.77 to 6.34	27.0 to 3.6	22.8 to 4.0	17.0 to 4.3
Light trucks	22.4 to 6.8	18.8 to 8.5	18.1 to 8.5	U	U	U	19.8 to 7.0	16.0 to 7.0	16.8 to 7.5

KEY: U = Data are unavailable.

NOTES

All Countries

Sales weighted average: Assumes 55 percent city and 45 percent highway travel.

Light trucks: Gross vehicle weight rating of zero kg to 3,856 kg (i.e., 8,500 pounds or less).

Averages and ranges: United States and Canada include both domestic and imported vehicles. Mexico includes only domestic vehicles.

SOURCES

Canada

Sales weighted average: Transport Canada. *Transportation in Canada, 1997—Annual Report, TP 13198.* (Ottawa, Ont.: 1998).

Ranges: Natural resources Canada. *Canada's Energy Outlook, 1996-2020.* (Ottawa, Ont.: 1997).

Transport Canada and Natural Resources Canada. *Fuel Consumption Guide, Annual.* (Ottawa, Ont.: various years).

Mexico

Secretaría de Energía. Comisión Nacional para el Ahorro de Energía, Dirección de Transporte. (Mexico City, D.F.: 1998).

United States

Sales weighted average: U.S. Department of Transportation. National Highway Traffic Safety Administration. Consumer Programs Division, NPS-32. (Washington, DC: 1998).

Ranges: U.S. Department of Transportation. National Highway Traffic Safety Administration. Automotive Fuel Economy Program. *Twenty-Second Annual Report to Congress.* (Washington, DC: various years).

U.S. Department of Transportation. National Highway Traffic Safety Administration. Consumer Programs Division, NPS-32. Private Communication. (Washington, DC: 1998).

table 4-6a

Federal Emission Control Requirements for Passenger Cars and Light Trucks: Model Year

(Grams of emissions per kilometer)

	Total hydrocarbons	Nonmethane hydrocarbons	Carbon monoxide (CO)	Cold temperature CO	Nitrogen oxides	Particulates
Canada, 1996						
Passenger cars	0.25	NA	2.1	NA	0.62	[a]0.12
Light trucks						
Under 1,701 kg, (loaded vehicle weight)	0.50	NA	6.2	NA	0.75	[a]0.16
Over 1,700 kg, (loaded vehicle weight)	0.50	NA	6.2	NA	1.1	[a]0.08
Mexico, model years 1995 and later						
Passenger cars	0.25	NA	2.11	NA	0.62	NA
Light trucks	0.63	NA	8.75	NA	1.44	NA
Under 3,857 kg, (gross vehicle weight)						
United States, model years 1994 and later						
Passenger cars						
Intermediate useful life	0.25	0.16	2.1	6.2	0.25	0.05
Full useful life	NA	0.19	2.6	NA	0.4	0.06
Light trucks						
1,701 to 2,608 kg, (loaded vehicle weight)						
Intermediate useful life	NA	0.20	2.7	6.2	0.4	[b]0.05
Full useful life	0.50	0.25	3.4	NA	0.60	[b]0.06

[a]Applies to diesel-fueled vehicles only.

[b]Phase-in begins with model-year 1995.

KEY: NA = Not applicable.

NOTES

All Countries

Light trucks are vehicles of about 3,856 kg or less gross vehicle weight rating (GVWR). For United States and Canada, the **exact** definition is 8,500 pounds or less, and, for the time period of this table, there are four and two categories of light trucks, respectively, within the range of zero through 8,500 pounds.

Canada

Loaded vehicle weight (LVW): See Appendix B under the United States for definition.

From September 1, 1997, Canadian standards are harmonized with U.S. standards by regulation, for all classes of on-road vehicles.

Passenger cars and light trucks: For cars (light-duty vehicles) and light trucks (light-duty trucks, LDT), Canadian 1996 regulated standards were technically equivalent to those of the United States for 1988 model year vehicles, but in practice, manufacturers and importers provided vehicles meeting U.S. 1996 standards.

Mexico

Particulates: No regulations are in effect for particulates for these vehicles.

United States

Useful life: The life over which the standards must be met. See Appendix B for a more complete definition.

Measurement units: The U.S. regulations are written in units of grams per mile. This table has converted the U.S. regulations to grams per kilometer. A simple conversion back to U.S. measures will result in rounding error and/or an incorrect level of precision in some cases. Appendix D provides the original U.S. measures.

Coverage: This table is a **simplification** of the U.S. emissions standards for passenger cars and light trucks.

Implementation schedules: Schedules are summarized in Appendix B. The standards were phased in over several years.

Passenger cars and light trucks: Data are for **gasoline-fueled vehicles only**. See Appendix B for the differences for diesel fueled vehicles.

Light trucks: There are four categories of light trucks. The regulations presented here are for the LDT2 category, which has a GVWR up to 2,722 kg (ie., 6,000 pounds or less) and a LVW of 1701 kg to 2,608 kg (i.e., 3,751 pounds through 5,750 pounds). (GVWR and LVR are defined in Appendix B.) In 1996, LDT2s accounted for more than 60 percent of the sales of new light trucks.

table 4-6a

Federal Emission Control Requirements for Passenger Cars and Light Trucks: Model Year–*Continued*

SOURCES

Canada

Transport Canada. Road Safety and Motor Vehicle Regulations Directorate. (Ottawa, Ont.: 1998).

Mexico

Instituto Nacional de Ecología. Diario Oficial de la Federación. *Norma Oficial Mexicana NOM-O42-ECOL-1993.* (Mexico City, D.F.: 1993).

United States

U.S. Code of Federal Regulations. (Washington, DC: 1998).

U.S. Environmental Protection Agency. Office of Air and Radiation. *Mobile Source Emissions Standards Summary.* (Washington, DC: 1992).

U.S. Environmental Protection Agency. Office of Air and Radiation. Office of Mobile Sources, Vehicle Programs and Compliance Division. *Tier 2 Study White Paper.* (Washington, DC: 1997).

table 4-6b

Federal Emission Control Requirements for Heavy Trucks: Model Year

(Grams of emissions per brake horsepower-hour)

	Total hydrocarbons	Carbon monoxide (CO)	Nitrogen oxides	Particulates	Smoke (percentage)
Mexico					
Compression ignition, model years 1994-1997 (weight more than 3,857 kg)	1.3	15.5	5.0	0.7 or 0.10	20/15/50
Spark ignition, model years 1995-1997					
Weight between 3,858 and 6,350 kg	1.1	14.4	5.0	NA	NA
Weight greater than 6,350 kg	1.9	37.1	5.0	NA	NA
United States and Canada, model years 1994 and later					
Compression ignition, model years 1994-1997 (weight more than 3,856 kg; i.e., more than 8,500 pounds)	1.3	15.5	5.0	0.10	20/15/50
Spark ignition, model years 1991-1997					
Weight between 3,856 and 6,350 kg	1.1	14.4	5.0	NA	NA
Weight greater than 6,350 kg	1.9	37.1	5.0	NA	NA

KEY: NA = Not applicable.

NOTES

All Countries

Compression ignition, smoke: Percentages apply to smoke opacity at acceleration/lug/peak modes.

Canada

From September 1, 1997, Canadian standards are harmonized with U.S. standards by regulation, for all classes of on-road vehicles.

Heavy trucks: For heavy trucks (heavy-duty vehicles), Canadian vehicles were provided to U.S. standards by a Memorandum of Understanding with the industry.

Mexico

Compression ignition, particulates: The limit is 0.10 for vehicles under 14,969 kg and 0.7 for vehicles over 14,969 kg.

United States

Compression ignition: Standards apply to both diesel and methanol-fueled engines.

Spark ignition: Standards apply to gasoline, methanol and liquified petroleum gas-fueled engines (LPG).

Spark ignition, weights: The first category of spark ignition heavy trucks in this table weighs more than 8,500 pounds and weighs 14,000 pounds or less. The second category weighs more than 14,000 pounds.

SOURCES

Canada

Transport Canada. Road Safety and Motor Vehicle Regulations Directorate. (Ottawa, Ont.: 1998).

Mexico

Instituto Nacional de Ecología. *Diario Oficial de la Federación. Norma Oficial Mexicana NOM-044-ECOL-1993.* (Mexico City, D.F.: 1993).

Secretaría de Medio Ambiente, Recursos Naturales y Pesca. *Diario Oficial de la Federación. Norma Oficial Mexicana NOM-076-ECOL-1995.* (Mexico City, D.F.: 1995).

United States

U.S. Environmental Protection Agency. Office of Air and Radiation. *Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines (EPA420-F-97-014).* (Washington, DC: 1997).

U.S. Environmental Protection Agency. Office of Air and Radiation. *Mobile Source Emissions Standards Summary.* (Washington, DC: 1992).